Home Wet Home

Objectives
Students will: (1) describe the stream or river components necessary for salmon spawning, (2) relate stream morphology to salmon survival and (3) identify structures in and near streams which benefit salmon.

Curricular Areas
Science, Environmental Science, English Language Arts

California Content Standards
GRADES 4-8

Science

4th Life 2 a, b, c; 3 a, b, c; Earth 5 c; Investigations 6 a, c

5th Physical Science 1 f, g; Life 2 a, f, g

6th Earth 2 a, b; Ecology 5 a, b, c, d, e; Resources 6 a, b, c

7th Earth/Life 4 c; Living Systems 6 a, b, c

8th Motion 1 a; Forces 2 a

Method
Students will assess a stream diagram and describe the components that provide suitable habitat for salmon. Students will explore the importance of riffles and pools by reading a narrative and completing a worksheet analysis.

Materials
- Time to complete: (1) 50-minute class period
- Copies of *Home Wet Home Facts*
- Copies of *Riffles and Pools Worksheet*
- Copies of *The River from Above*

Background
Habitat is the key to survival. The ideal salmon and steelhead environment is a fast-flowing stream with cold, clear, and pollution-free water. The stream or river should meander and offer a variety of depths and rock and gravel size. Streamside vegetation, known as riparian, should include a thick canopy and lush understory.

Water quality is important and can be influenced by streamside habitat, pollutants, and upstream development. Water levels should be stable during the course of the run and after redds (nests for fertilized eggs) are established. Water level in a stream is a critical factor since water temperatures fluctuate with the flow level of the stream. If the stream flow is too low, the water will be warm, and adult salmon may not enter the stream to spawn. Warm water temperatures during egg incubation may mean that eggs hatch before the spring food supply is available and may be more susceptible to fungus. Floods can destroy nests or cover them with silt. Droughts can cause a detrimental warming trend.

Gravel, rocks, and boulders are essential elements for salmon survival. They break up the flow of water and allow oxygen to aerate the water. The fast-moving cold water can carry oxygen to the eggs and keep them clear of silt and waste. Rocks also provide breeding grounds for insects, which serve as food for the young salmon. Hiding spaces between boulders and within white-water areas offer protection for young salmon.

The meandering of a river or stream causes different flow rates within the stream. Therefore, rocks and vegetation are deposited to form pools, riffles, and rapids. Lateral areas along the outside edge of a meander are calmer and provide habitat for young fish and other organisms.

Pools are areas of deeper and slower water. They are important feeding and resting areas for fish. They are generally formed around bends in the stream, root wads, or boulders. Pools have three distinct areas:

1. Head: Turbulent water at the head of the stream provides higher levels of dissolved oxygen and food carried from upstream.
2. Body: Slower water allows the organic materials to settle, decompose, and produce carbon dioxide and other nutrients needed by plants. The drifting organic particles provide food for invertebrates.

3. Tailout: Depending on the gradient, gravel collects with the faster moving water and provides spawning areas for salmon. Stable gravel beds clear of sediment usually are located here. It is crucial that the beds can withstand flooding, which could disturb spawning beds.

Riffles are portions of a stream that are relatively shallow, fast, and steep. They often have bedrock, cobbles, and sometimes boulders. Cobbles and boulders create rapids and cascades. In shallow riffles the sunlight encourages algae to grow on the rocks. The gravel and cobbles provide nooks and crannies for insect larvae to hide and feed. Biologists consider a one-to-one pool to riffle ratio as part of a healthy spawning stream.

Lateral areas along the edges of streams are shallow and quiet. Boulders, root wads, or logs can form small pools or eddies. Fine sediments and gravels are found here.
Accumulations of organic materials provide rich food sources for invertebrates. These areas provide important rearing habitat for young fish. However, predators wait for young salmon in these areas.

Streamside vegetation or riparian habitats provide bank stability, temperature control, and insect habitat that provide a food source. Undercut banks, stable natural debris, and overhanging vegetation provide protection from the sun and predators for young fish. In colder climates, streamside vegetation can keep the water slightly warmer for young fish. Leaf litter assists with the aquatic insect production. Riparian vegetation also protects banks from erosion, thereby limiting the amount of silt that can damage incubating eggs in the spawning stream.

Limiting factors establish the salmon and steelhead carrying capacity of a stream. They must be considered for all phases of a life cycle. When spawning grounds are limited, excessive numbers of adults dislodge previously deposited eggs. Therefore, quantity and quality of riffle areas and spawning gravel in a stream are limiting factors for spawning production. If too many juveniles exist in rearing areas, competition for food and space force juveniles into less suitable areas. Predation, lack of food, and sun exposure may limit these populations. Therefore, quantity and quality of juvenile nursery areas or pools are limiting factors for rearing juvenile salmon and steelhead ready for migration to the ocean.

Salmon and steelhead populations fluctuate from year to year because of varying environmental factors.

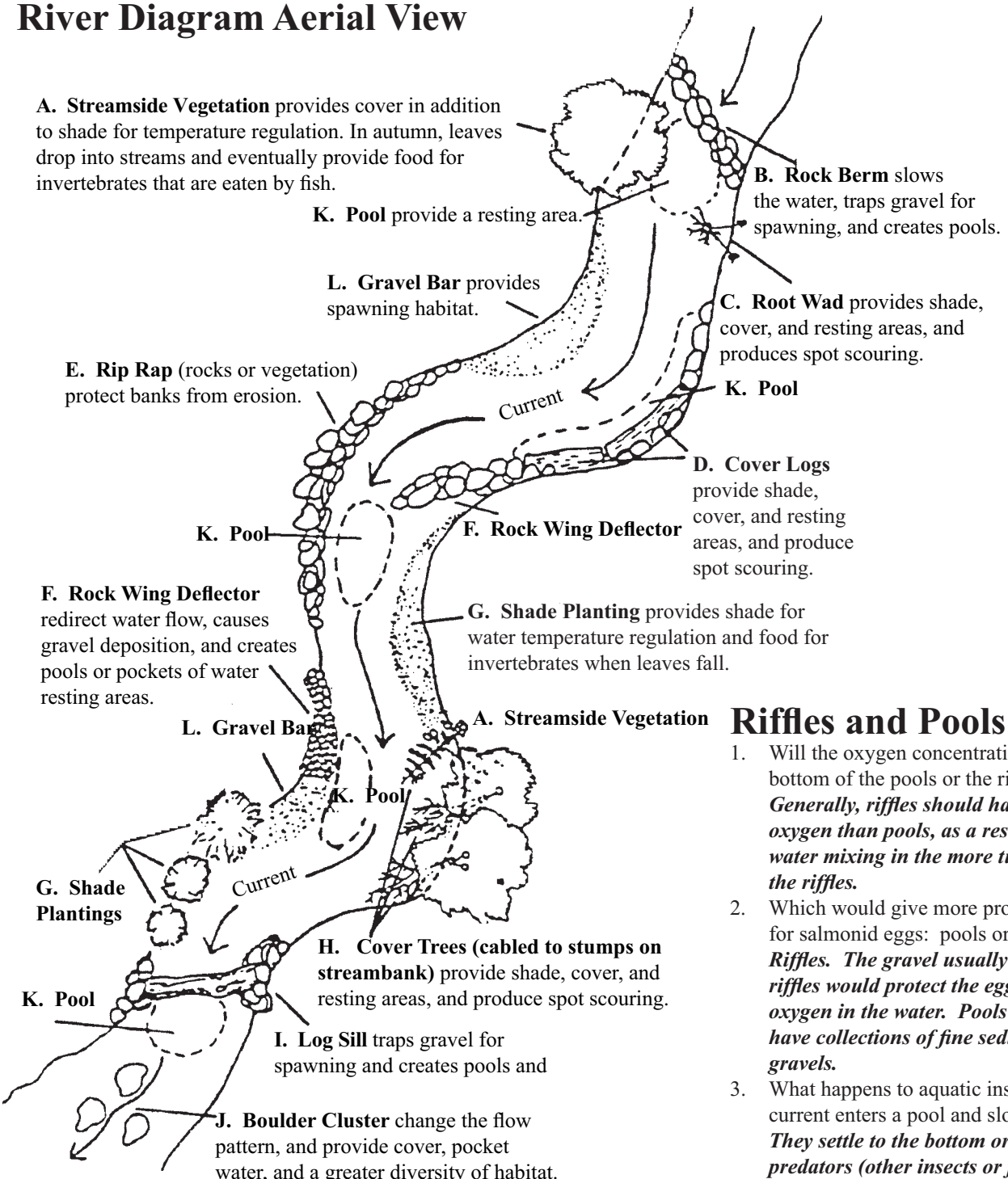
Procedure

1. Ask students to name the four components necessary for a good habitat (food, water, shelter and space). These elements are needed in the proper arrangement to provide for an animal's survival. Where is a salmon's habitat? Does a good salmon habitat involve more than just the water?
2. Have the students read the *Home Wet Home Facts*.
3. Pass out the *The River from Above* and the *Riffles and Pools Worksheet*. (The *Teacher Reference* sheet has the answers to these activities.) Have the students work in pairs to assess the value that each letter, A to J, of the river diagram holds for salmon habitat, and record assessment for class discussion. Complete the *Riffles and Pools Worksheet*.
4. Review and discuss worksheets. Lead students in a discussion of the importance of spawning habitat.
    - How could limited spawning habitat affect the salmon runs in the future?
    - If salmon could not find enough habitat, would salmon in the later part of the run build their redds on top of nests deposited from fish in the earlier part of the run?
    - If water flow is controlled by an upstream dam, how could these flows impact spawning habitat?
    - The vegetation along the river is important to the quality of salmon habitat. How does vegetation relate to water quality?

Activity adapted from *Some Things Fishy*, by the CA Department of Water Resources, Office of Education and *The Fish Hatchery Next Door...* from the Oregon Department of Fish and Wildlife.

Teacher Reference

River Diagram Aerial View



Riffles and Pools Answers

1. Will the oxygen concentration be higher at the bottom of the pools or the riffles?
   Generally, riffles should have more dissolved oxygen than pools, as a result of air and water mixing in the more turbulent water of the riffles.
2. Which would give more protection and oxygen for salmonid eggs: pools or riffles? Why?
   Riffles. The gravel usually found in the riffles would protect the eggs. Riffles help put oxygen in the water. Pools are more likely to have collections of fine sediments rather than gravels.
3. What happens to aquatic insect larvae as the current enters a pool and slows down?
   They settle to the bottom or are eaten by predators (other insects or fish).
4. Where would be the best place for salmonid fry to wait for lunch? Why?
   Fry should wait at the head of a pool or tail of a riffle in order to be first in line for drifting insects.
5. Where would salmonid fry use the most energy catching food? Why?
   Salmon fry would use the most energy on the riffles; it is harder to maintain position in the faster water of a riffle.

Home Wet Home Facts

Salmon and steelhead are important to us; their presence helps indicate the health of the waterway. Biologists refer to salmon as an "indicator or keystone species" because they are one of the first organisms to be affected with habitat change.

What are the habitat needs for salmon and steelhead?

- Cool, clear, well-oxygenated water
- Sections of gravel bottom for spawning
- Occasional pools for feeding and resting
- Adequate food (aquatic and terrestrial insects)
- Cover for protection from predators

Salmon need lots of oxygen to live, and they get all their oxygen from the water. Salmon must have cold water; it has more oxygen than warm water. Shade helps by cooling the water and keeping its oxygen content high. Trees and bushes provide shade for streams and rivers. Also, oxygen is added to water when it flows over fallen trees, rocks, waterfalls and riffles; scientists call this "dissolved oxygen." Riffles are rocky shallows where the water flows swiftly, making little waves and putting more oxygen into the water.

Salmon need to lay their eggs in clean gravel without silt. Silt is soil dissolved in water. Silt can smother salmon eggs or alevin. It clogs the gills of older fish, too, so that they can't breathe. Trees, bushes and grasses help prevent silt because the roots keep the soil in place.

Young salmon eat aquatic insects and larvae. These insects and larvae, in turn, depend on nutrients that seep into the water from organic matter such as leaves, fallen submerged trees, and the decaying carcasses of spawned-out salmon.

Salmon need pools and ponds where they can rest and hide from predators. Trees that fall in streams form pools. Pools may be formed by beaver-created dams. Also, large rocks may be placed in a way that creates pools. Pools are usually areas of slower moving water. Aquatic insects tend to be found in this area because the

Riffles and Pools Worksheet

Look carefully at the drawings. Answer the questions based on your own experience and the information in this exercise.

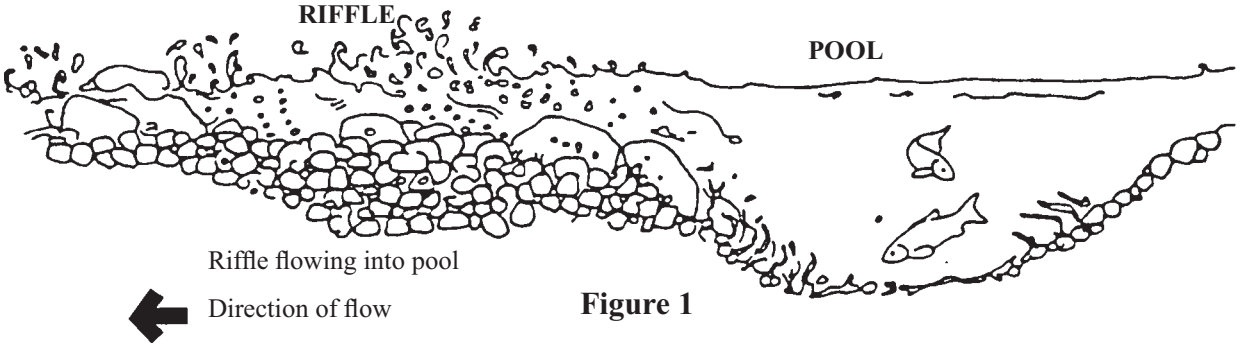


Figure 1

1. In figure 1, will the dissolved oxygen concentration be higher at the bottom of the pools or in the riffles?

2. In Figure 1, would pools or riffles provide more protection and oxygen for salmon eggs? Why?

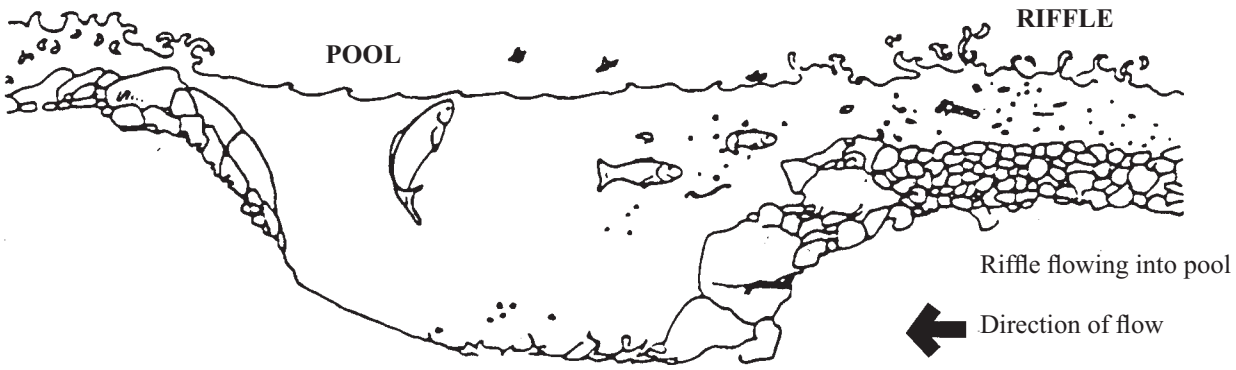


Figure 2

3. In Figure 2, what happens to aquatic insect larvae as the current enters a pool and slows down?

4. In Figure 2, where would salmon fry have the best chance of finding lunch? Why?

5. In Figure 2, where would salmon fry use the most energy catching food? Why?

The River from Above